POLITECNICO
MILANO 1863

AIRLAB
ARTIFICIAL INTELLIGENCE AND ROBOTICS LAB

Cosa intendiamo per Intelligenza Artificiale?

… tutto ciò che avreste voluto sapere e non avete mai osato chiedere!

Ho chiaramente un bias sull'analisi di immagini!

Matteo Matteucci
matteo.matteucci@polimi.it

Artificial Intelligence and Robotics Lab - Politecnico di Milano

Smartphone o telefono intelligente?

Dovrebbe funzionare anche al cinema, a teatro, a lezione, in Chiesa, in un ospedale …

Non devo certo chiedervi se lo avete silenziato ….

- Grazie al GPS sa dove siete
- Le mappe online dicono che questa è una sala conferenze
- Il calendario sul web dice che è in corso un seminario di un famoso cattedratico (circa)
- Poche righe di codice e il cellulare è silenziato!

Smartphone o telefono intelligente?

Dovrebbe funzionare anche al cinema, a teatro, a lezione, in Chiesa, in un ospedale …

Il software dovrebbe controllare in una (lunga) lista (e.g., ospedale, teatro, classe, cinema) …

oppure

basterebbe un po' di "senso commune":

- *"Una persona che parla non andrebbe interrotta"*
- *"Le persone vengono interrotte da una suoneria"*
- *"Le suonerie disturbano in posti silenziosi"*

E' possibile dotare le macchine di senso commune?

Macchine con un senso comune ...

Dotare i computer di capacità cognitive e senso commune è uno degli obiettivi dell'Intelligenza Artificiale:

- *"Gli oggetti cascano verso il basso e non in alto"*
- *"Le persone al mattino fanno colazione"*
- *"Non si ordina un Cappuccino cinque del pomeriggio"*
- *...*

Raccogliere e codificare il senso comune ...

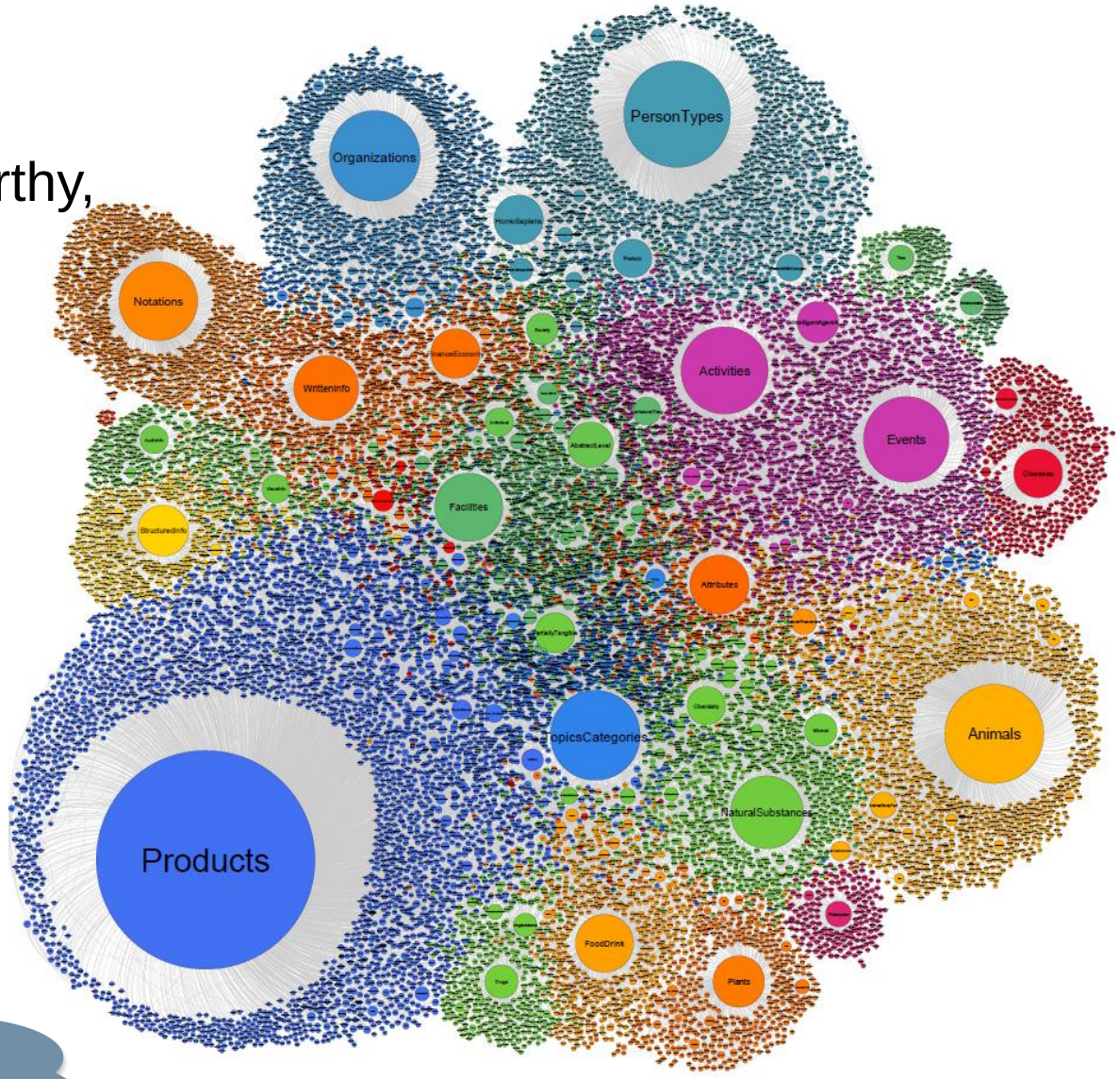
Pionieri dell'Intelligenza Artificiale come McCarthy, Minsky, Lenat e (molti) altri hanno cominciato a collezionare conoscenze

- Cyc (1984) diventato poi Cycorp (1994)
  239,000 concetti
  2,093,000 fatti

```
(#$capitalCity #$France #$Paris)
```

```
(#$implies
   (#$and
     (#$isa ?OBJ ?SUBSET)
     (#$genls ?SUBSET ?SUPERSET))
   (#$isa ?OBJ ?SUPERSET))
```

Una base di conoscenza per il ragionamento (automatico)



... o apprendere il senso comune?

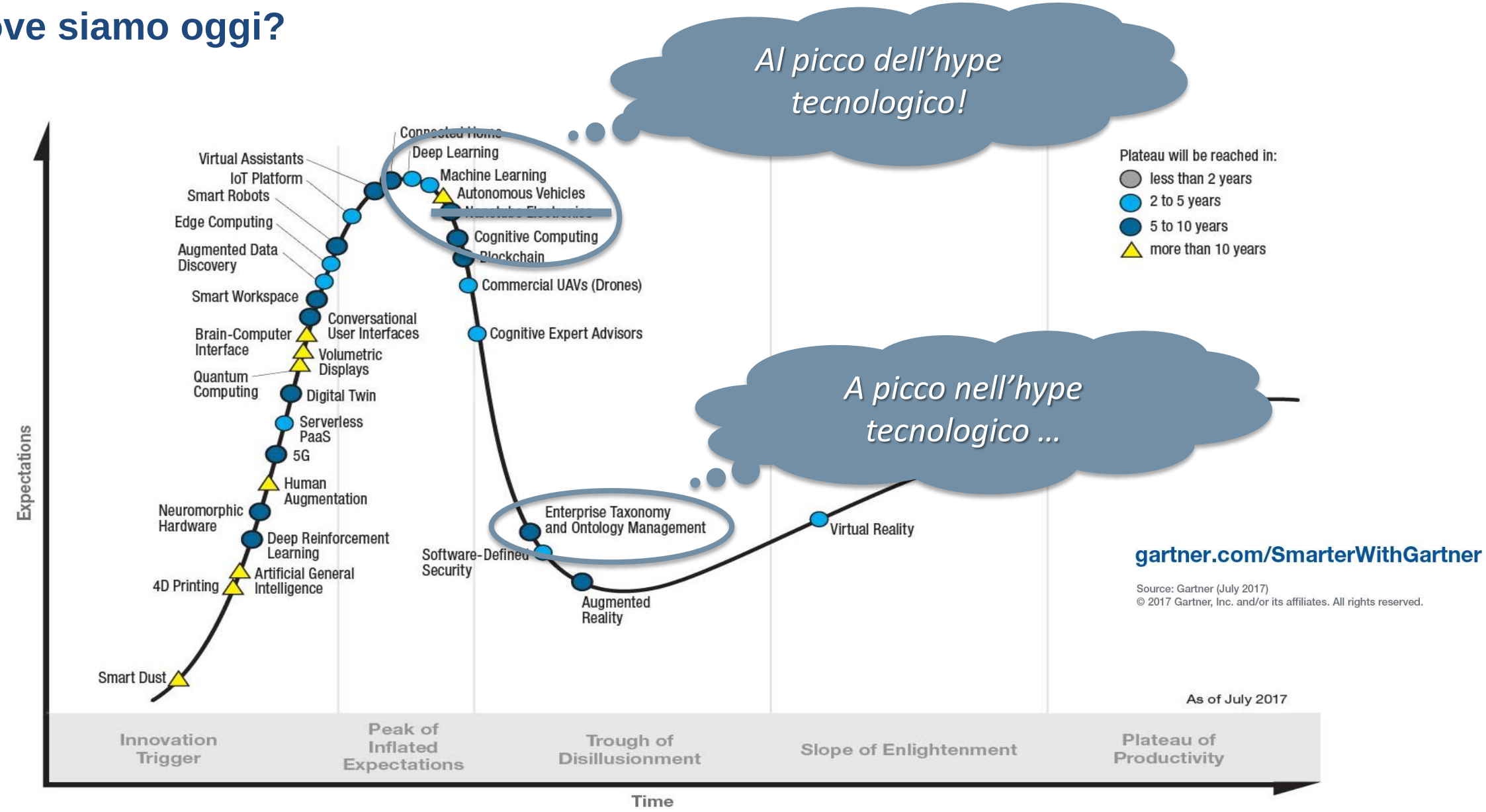
“Human-level intelligence requires gaining experience from interacting with humans, like human infants do.”

COG aveva l’obiettivo di apprendere il senso commune attraverso:

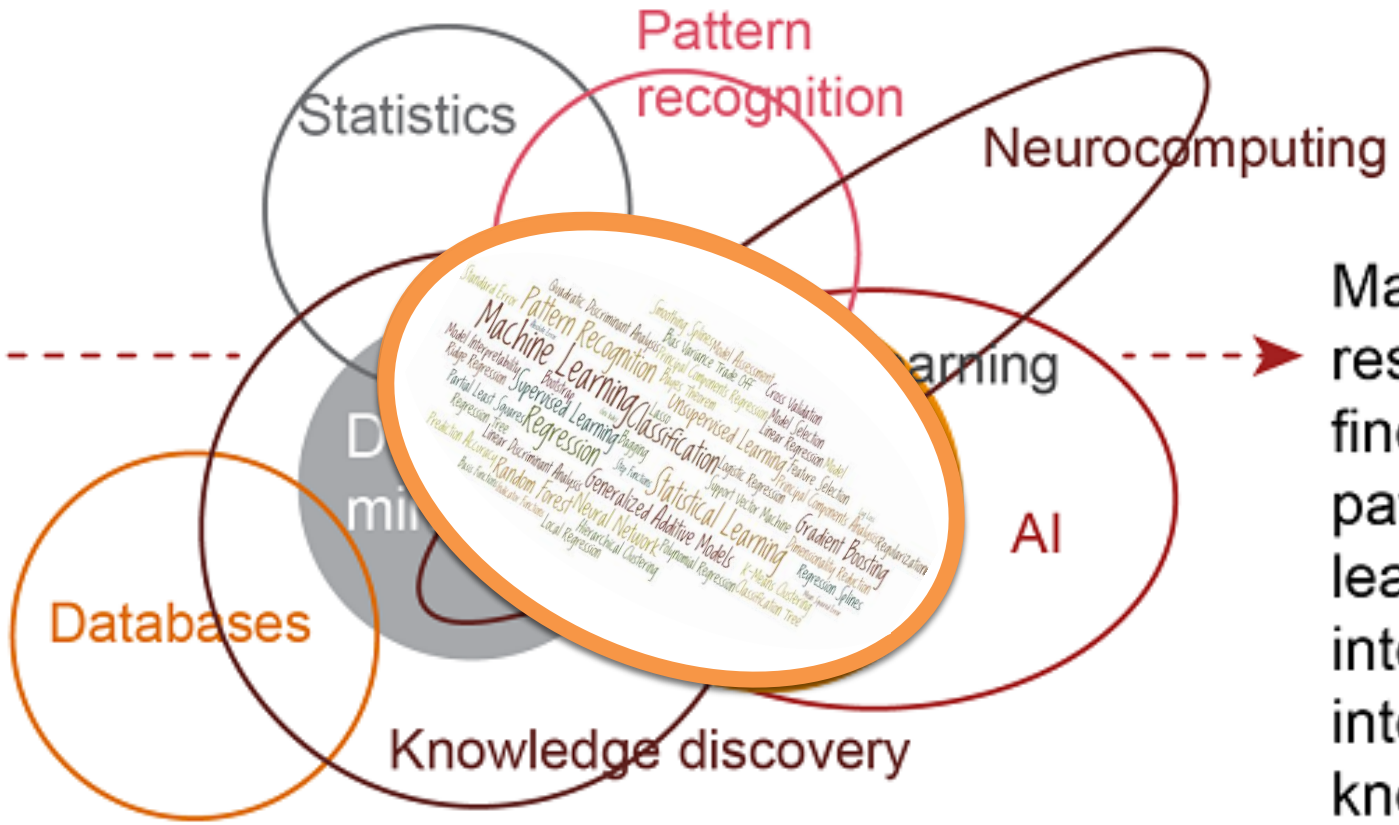
- Prolungata interazione e imitazione dell’uomo
- Apprendimento continuo dall’interazione con il mondo reale

Estrarre conoscenza dai dati attraverso l’apprendimento automatico

Dove siamo oggi?



Apprendimento Automatico

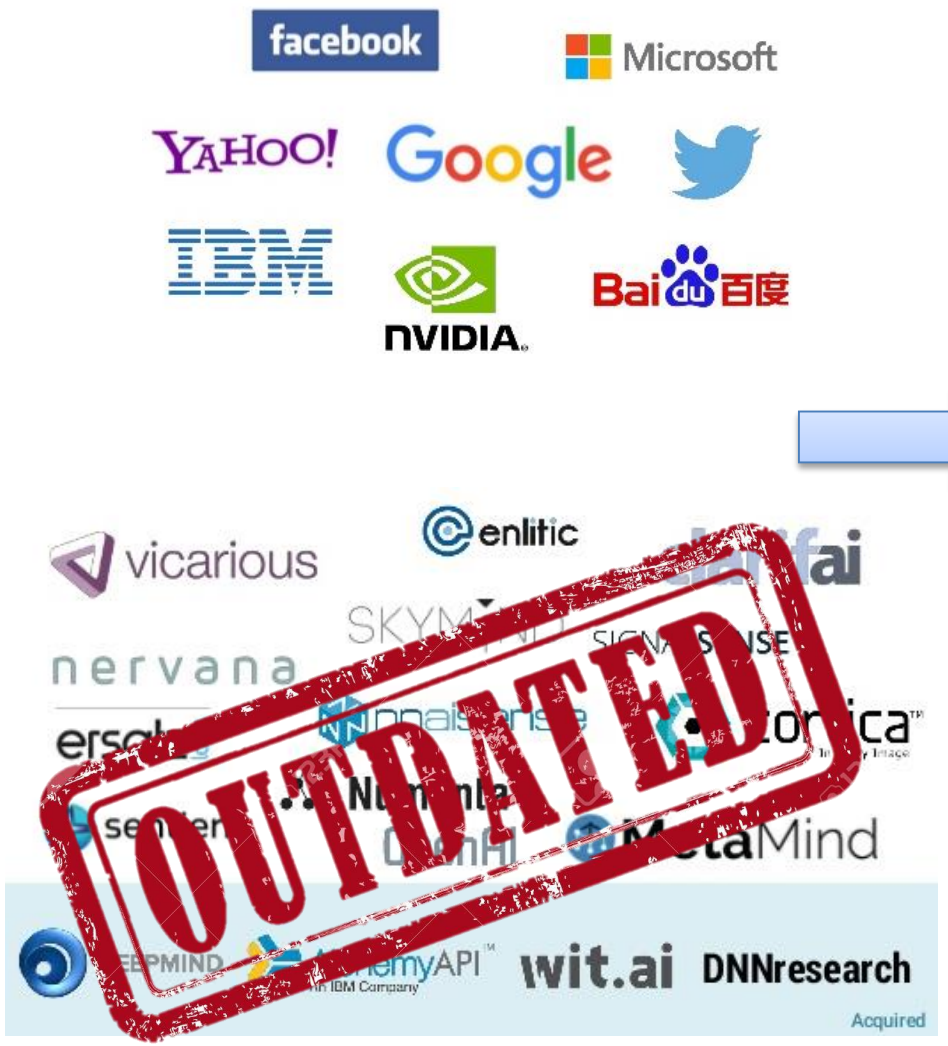


Machine learning is a category of research and algorithms focused on finding patterns in data and using those patterns to make predictions. Machine learning falls within the artificial intelligence (AI) umbrella, which in turn intersects with the broader field of knowledge discovery and data mining.

Source: SAS, 2014 and PwC, 2016 *and myself, 2017*

Apprendimento Automatico

Deep Learning Explosion



MIT Technology Review

10 BREAKTHROUGH TECHNOLOGIES 2013

Introduction | The 10 Technologies | Past Years

Deep Learning

With massive amounts of computational power, machines can now recognize objects and translate speech in real time. Artificial intelligence is finally getting smart.

Temporary Social Media

Messages that quickly self-destruct could enhance the privacy of online communications and make people freer to be spontaneous.

Prenatal DNA Sequencing

Reading the DNA of fetuses will be the next frontier of the genomic revolution. But do you really want to know about the genetic problems or musical aptitude of your unborn child?

Additive Manufacturing

Skeptical about 3-D printing? GE, the world's largest manufacturer, is on the verge of using the technology to make jet parts.

Baxter: The Blue-Collar Robot

Rodney Brooks's newest creation is easy to interact with, but the complex innovations behind the robot show just how hard it is to get along with people.

Memory Implants

A maverick neuroscientist believes he has deciphered the code by which the brain forms long-term memories. Next: testing a prosthetic implant for people suffering from long-term memory loss.

Smart Watches

The designers of the Pebble watch realized that a mobile phone is more useful if you don't have to take it out of your pocket.

Ultra-Efficient Solar Power

Doubling the efficiency of a solar cell would completely change the economics of renewable energy. Nanotechnology just might make it possible.

Big Data from Cheap Phones

Collecting and analyzing information from simple cell phones can provide surprising insights into how people move about and behave – and even help us understand the spread of diseases.

Supergrids

A new high-power circuit breaker could finally make highly efficient DC power grids practical.

Enabling Cross-Lingual Conversations in Real Time

Microsoft Research
May 27, 2014 5:58 PM PT

The success of the team's progress to date was on display May 27, in a talk by Microsoft CEO Satya Nadella in Rancho Palos Verdes, Calif., during the Code Conference. During Nadella's conversation h Kara Swisher and Walt Mossberg of Re/code tech website relating to a new of personal computing, he asked deep Pall to join him on stage. Pall, the rosoft corporate vice president of pe, demonstrated for the first time licly the Skype Translator app, with Pall versing in English with German-

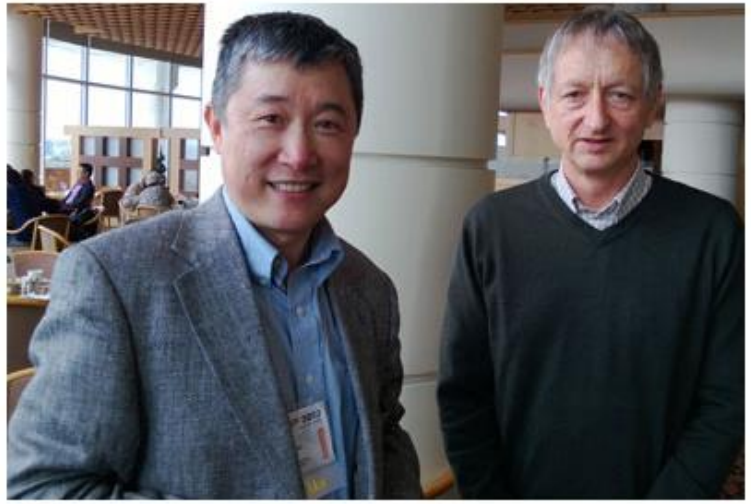
View milestones on the path to Skype Translator

#speech2speech

Microsoft's Skype "Star Trek" Language Translator Takes on Tower of Babel

May 27, 2014, 5:48 PM PDT

Remember the universal translator on Star Trek? The gadget th to aliens?

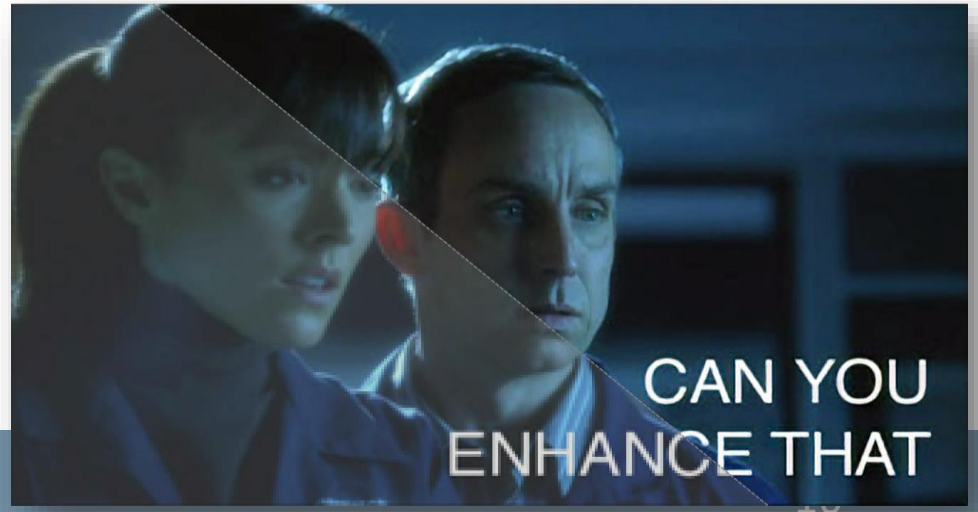


Li Deng (*left*) and Geoff Hinton.

A core development that enables Skype translation came from Redmond researcher Li Deng. He invited Geoff Hinton, a professor at the University of Toronto, to visit Redmond in 2009 to work on new neural-network learning methods, based on a couple of seminal papers from Hinton and his collaborators in 2006 that had brought new

The path to the Skype Translator gained momentum with an encounter in the autumn of 2010. Seide and colleague Kit Thambiratnam had developed a system they called The Translating! Telephone for live speech-to-text and speech-to-speech translation of phone calls.

umbrella.99
person1.00
person1.00
person1.00
car.99
car.93
person1.00
handbag.93
skateboard.98
skateboard.99
person1.00
person1.00
person1.00
person.95
sports ball.98
sports ball1.00
imax PHOTOGRAPHY
brewers.com


CAN YOU
ENHANCE THAT

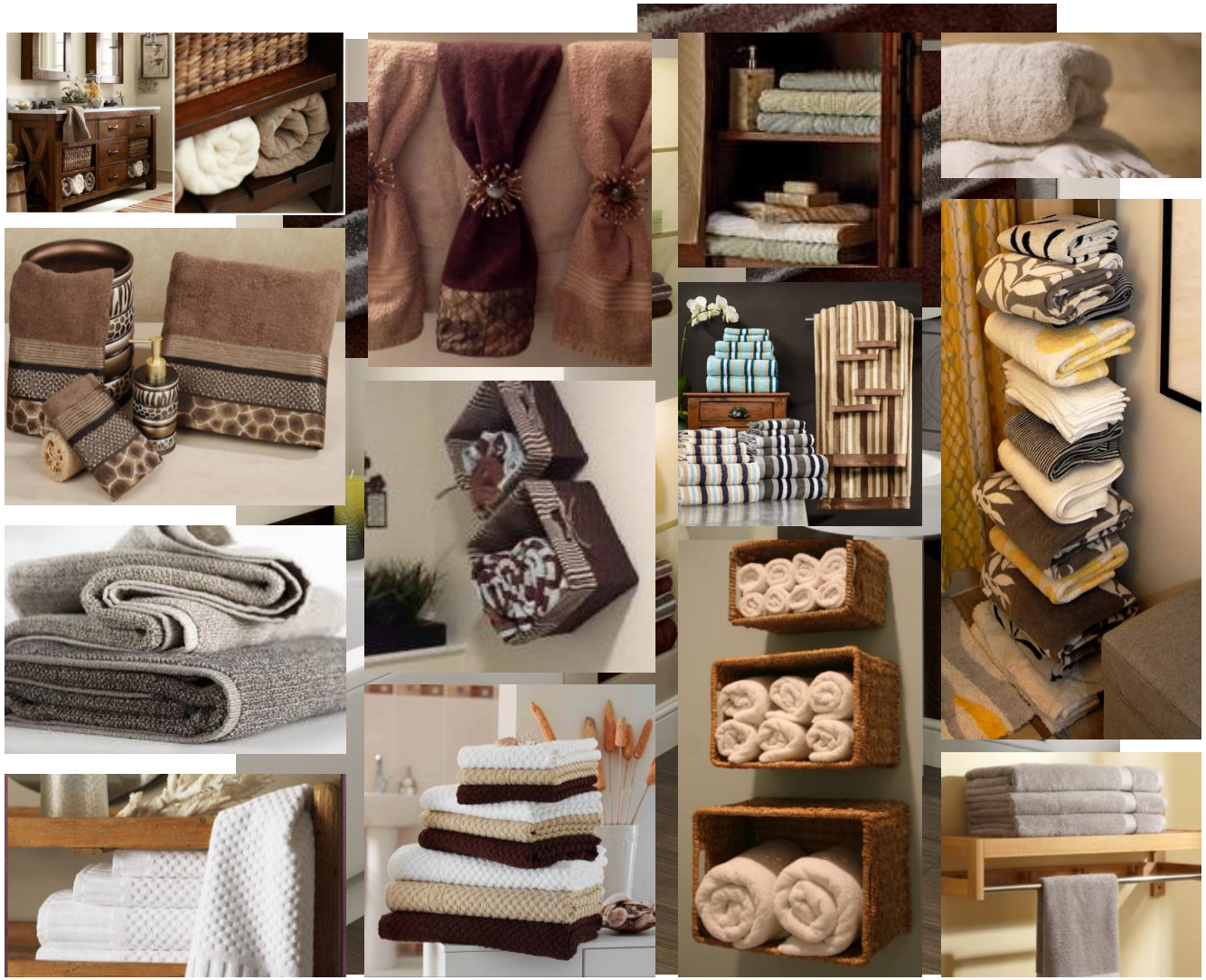
Deep learning in pillole

Riuscite a indovinare cosa è?

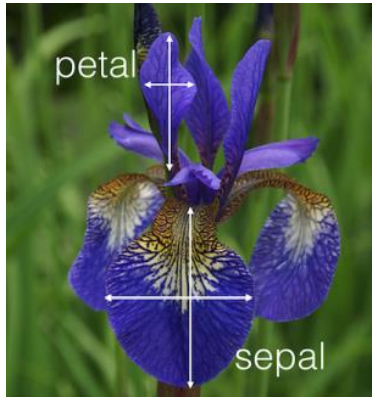
E se lo ingrandiamo?

Proviamo ad aggiungere contesto e senso comune

È possibile farlo apprendere a una machina da grosse quantità di dati?

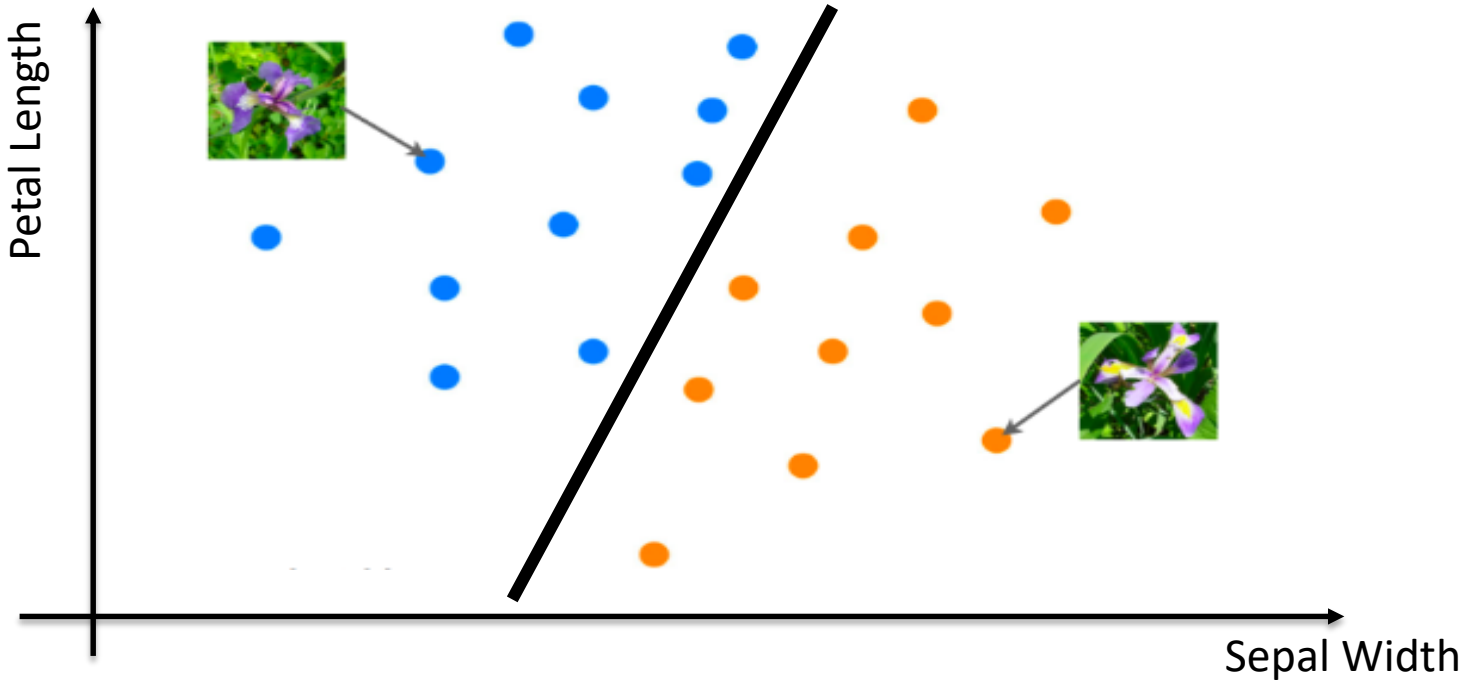


C’era una volta il machine learning ...

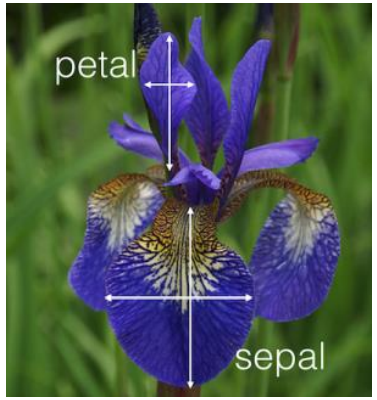


Feature progettate «a mano» → Classificatore appreso dai dati → ***setosa***

Approccio classico (2006 – 2012)

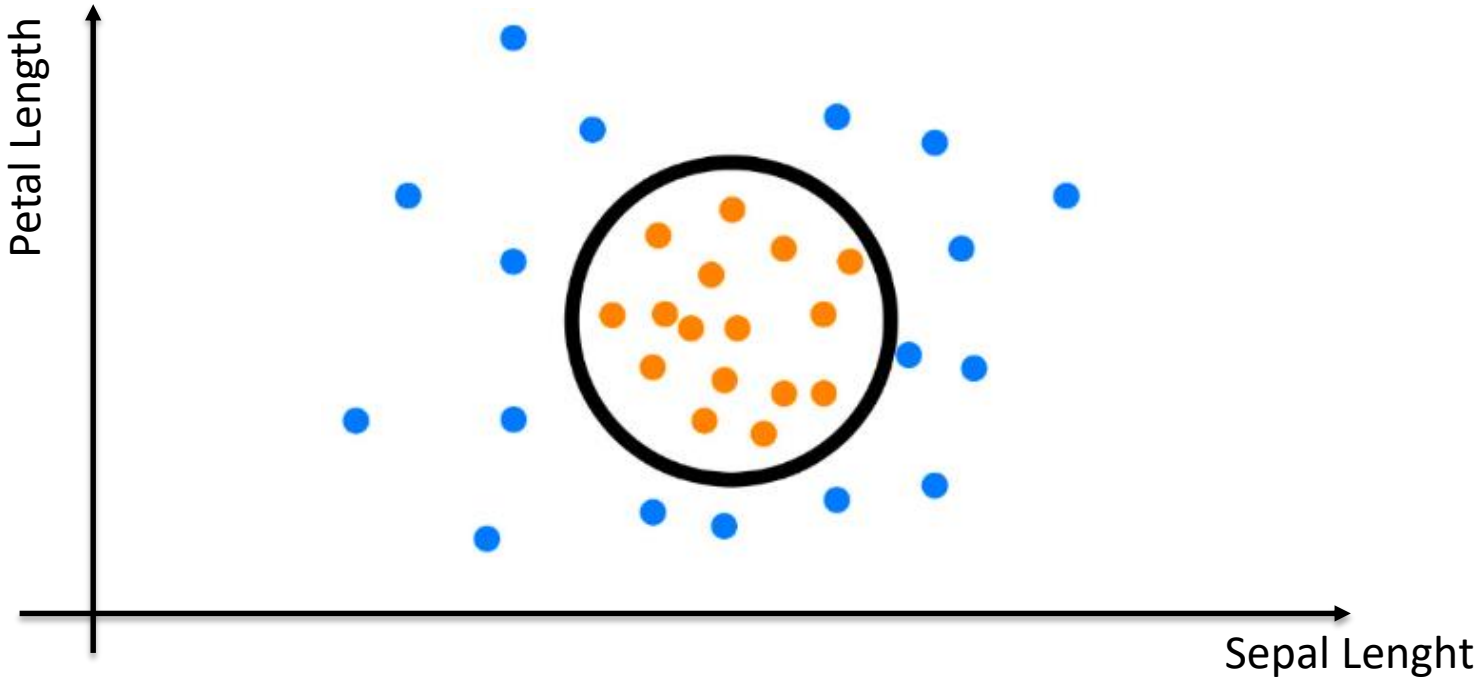


C’era una volta il machine learning ...



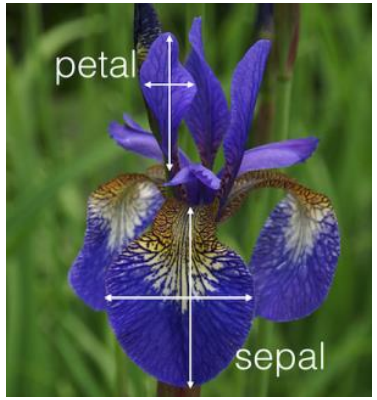
Feature progettate «a mano» → Classificatore appreso dai dati → ***setosa***

Approccio classico (2006 – 2012)



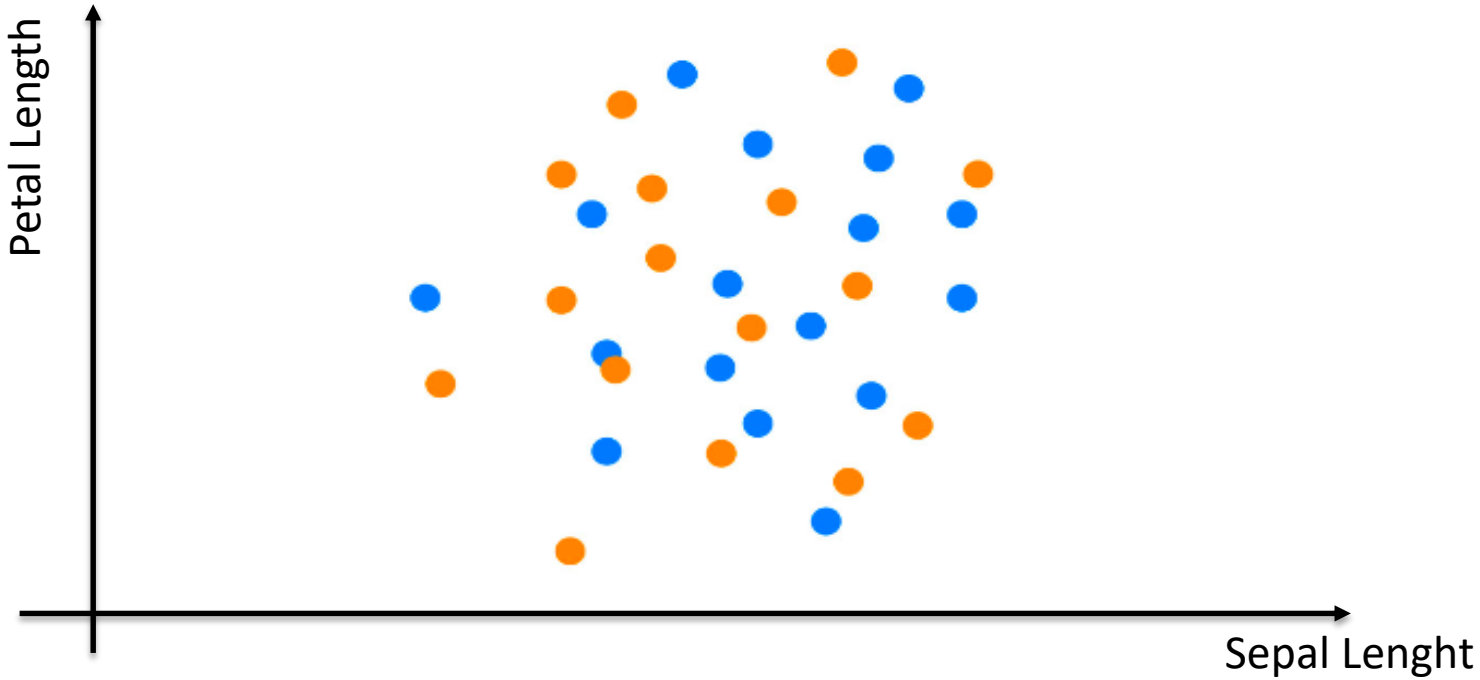
C'era una volta il machine learning ...

E se avessimo sbagliato a progettarle?



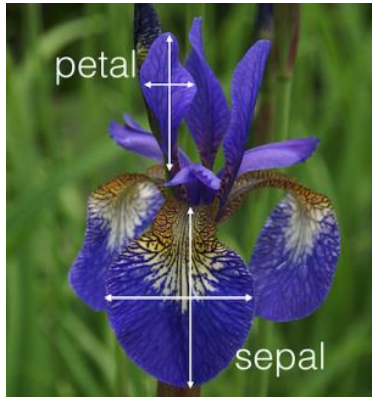
Feature progettate «a mano» → Classificatore appreso dai dati → ***setosa***

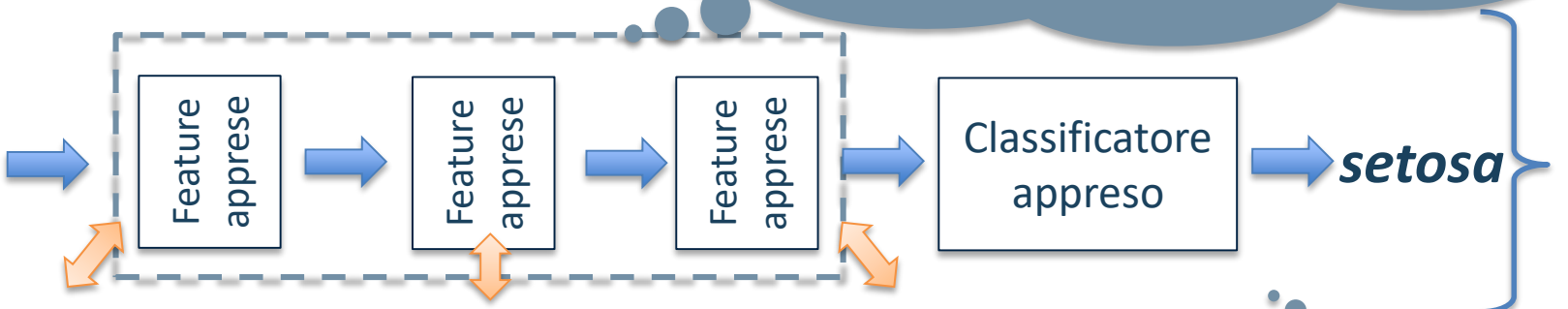
Approccio classico (2006 – 2012)



… oggi c'e' il deep learning!

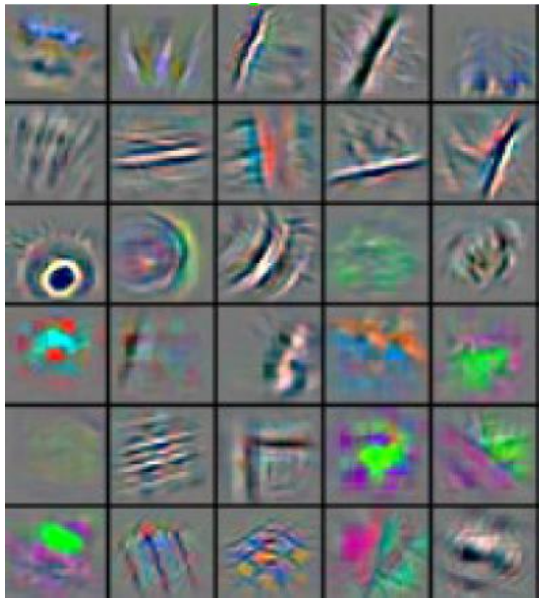
Deep Learning non è niente altro che apprendere le feature da grosse quantita' di dati!





Deep Learning (2012 – …)

Chi ce li da tutti questi dati?

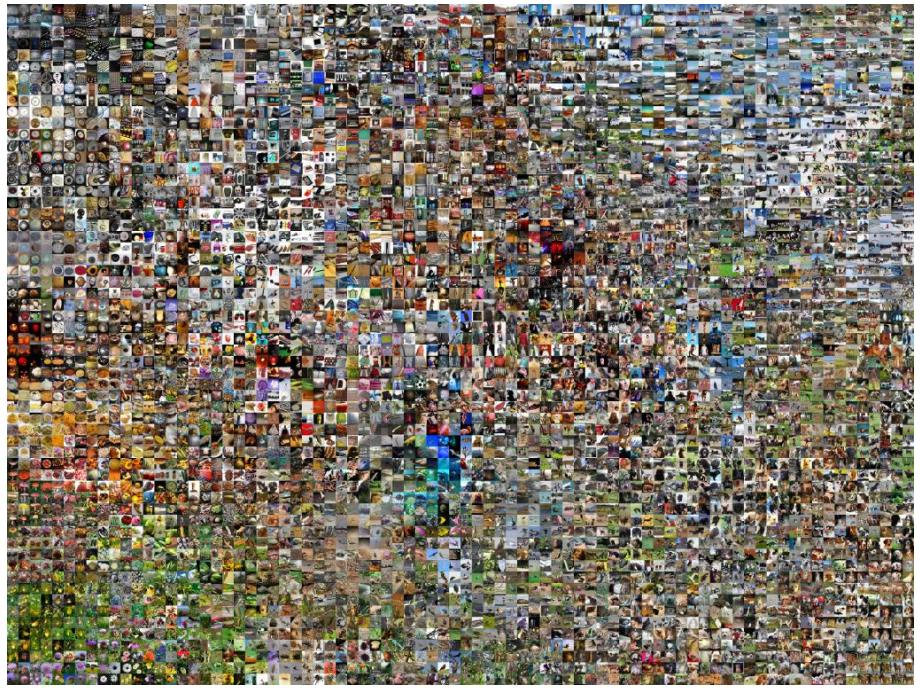


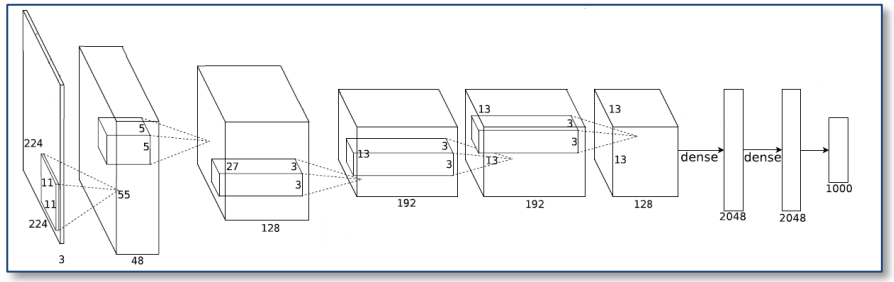
IN 60 SECONDS...
1 NEW DEFINITION IS ADDED ON urban
1,600+ READS ON Scribd.
13,000+ HOURS MUSIC STREAMING ON PANDORA
12,000+ NEW ADS POSTED ON craigslist
370,000+ MINUTES VOICE CALLS ON skype
98,000+ TWEETS
20,000+ NEW POSTS ON tumblr.
THE LARGEST SOCIAL READING PUBLISHING COMPANY!!
New Craigslist Ads
320+ NEW twitter ACCOUNTS
100+ NEW LinkedIn ACCOUNTS
13,000+ iPhone APPLICATIONS DOWNLOADED
1 associatedcontent NEW ARTICLE IS PUBLISHED
THE WORLD'S LARGEST COMMUNITY CREATED CONTENT!!
QUESTIONS ASKED ON THE INTERNET...
100+ Answers.com
40+ YAHOO! ANSWERS
6,600+ NEW PICTURES ARE UPLOADED ON flickr
600+ NEW VIDEOS
50+ WORDPRESS DOWNLOADS
25+ HOURS TOTAL DURATION
70+ DOMAINS REGISTERED
695,000+ facebook STATUS UPDATES
125+ PLUGIN DOWNLOADS
60+ NEW BLOGS
168 MILLION EMAILS ARE SENT
694,445 SEARCH QUERIES
1,700+ Firefox DOWNLOADS
1,500+ BLOG POSTS
79,364 WALL POSTS
510,040 COMMENTS
Google
Google Search

IMAGENET

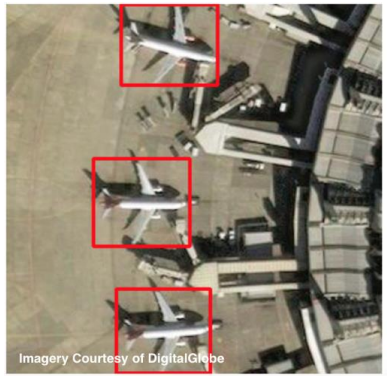
1000 categorie, 1.5 Millioni di immagini etichettate (2012)

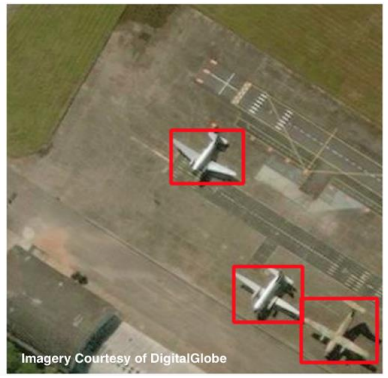
Supervision (ImageNet - 2012)



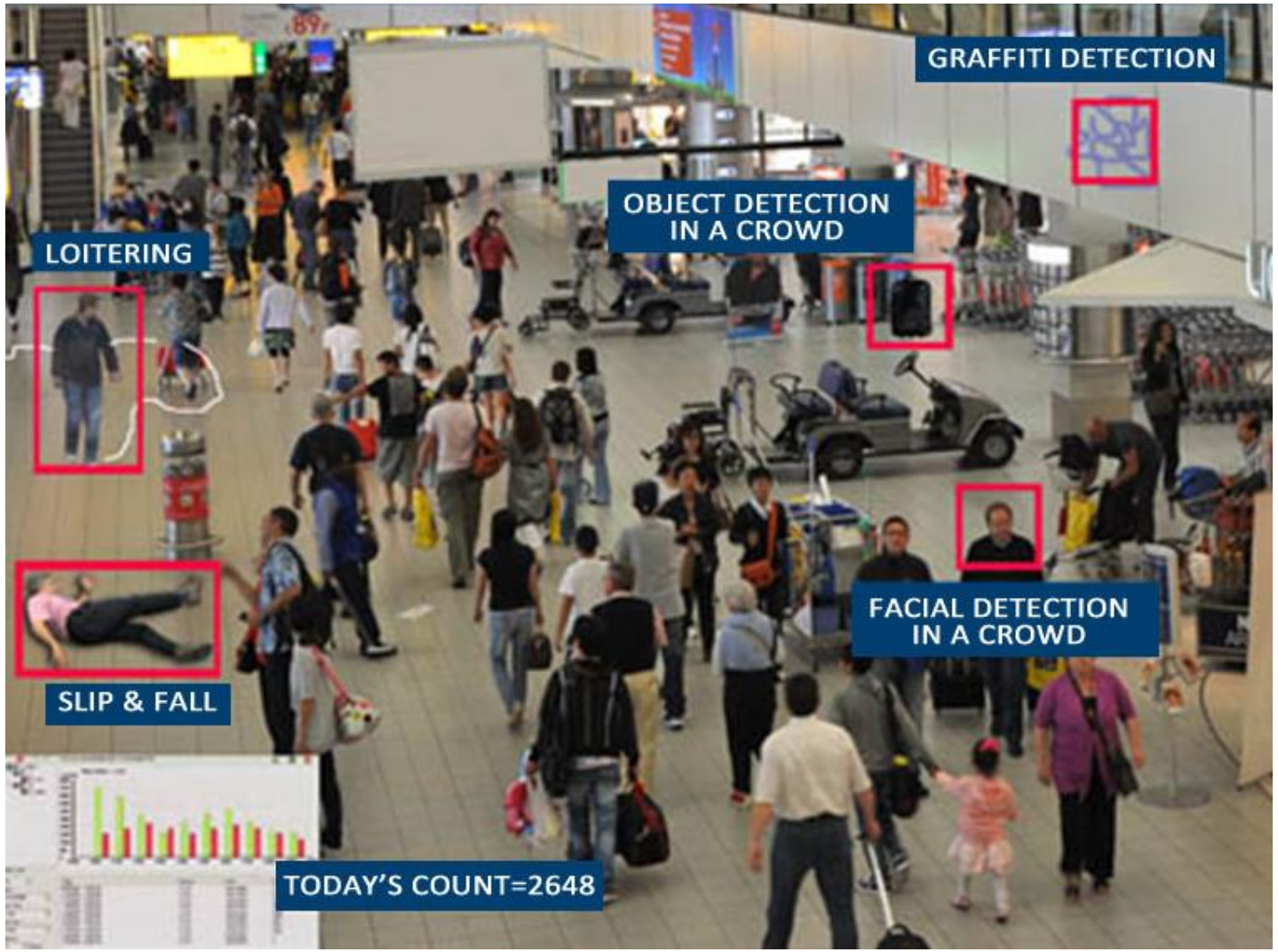


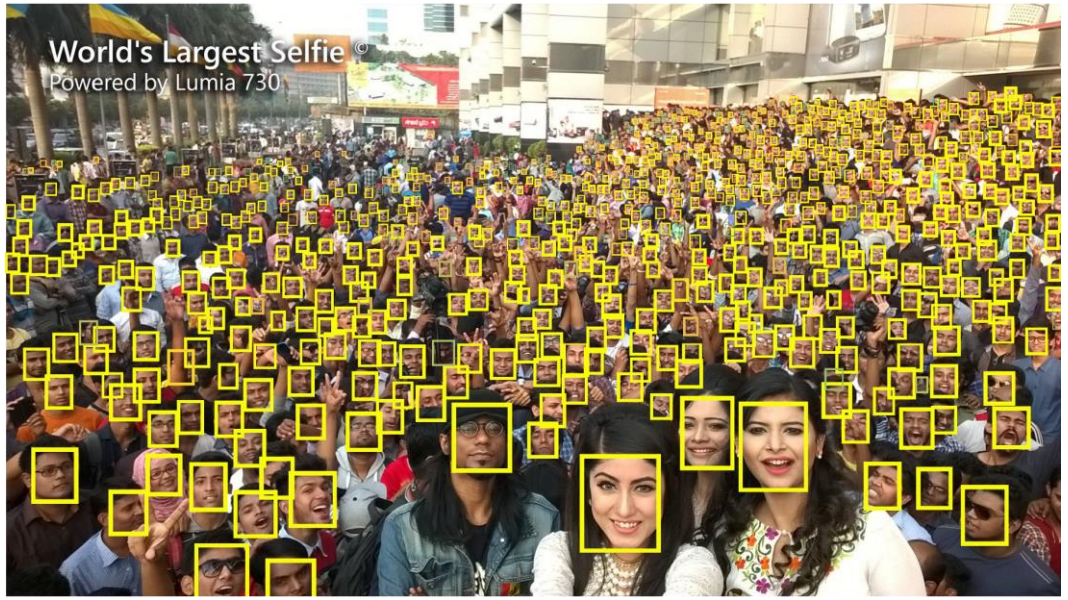
Airborne data analysis ...



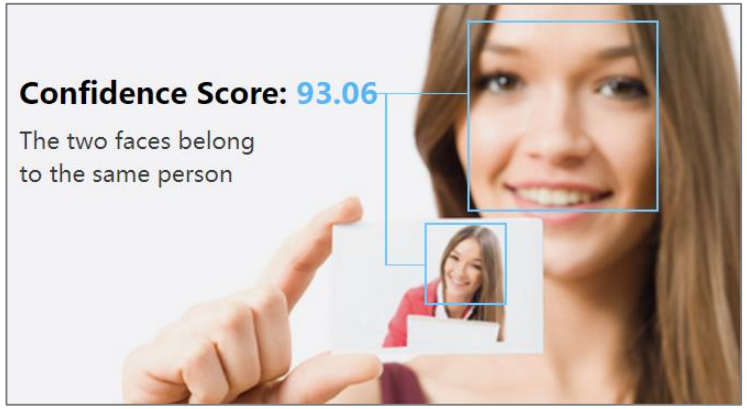


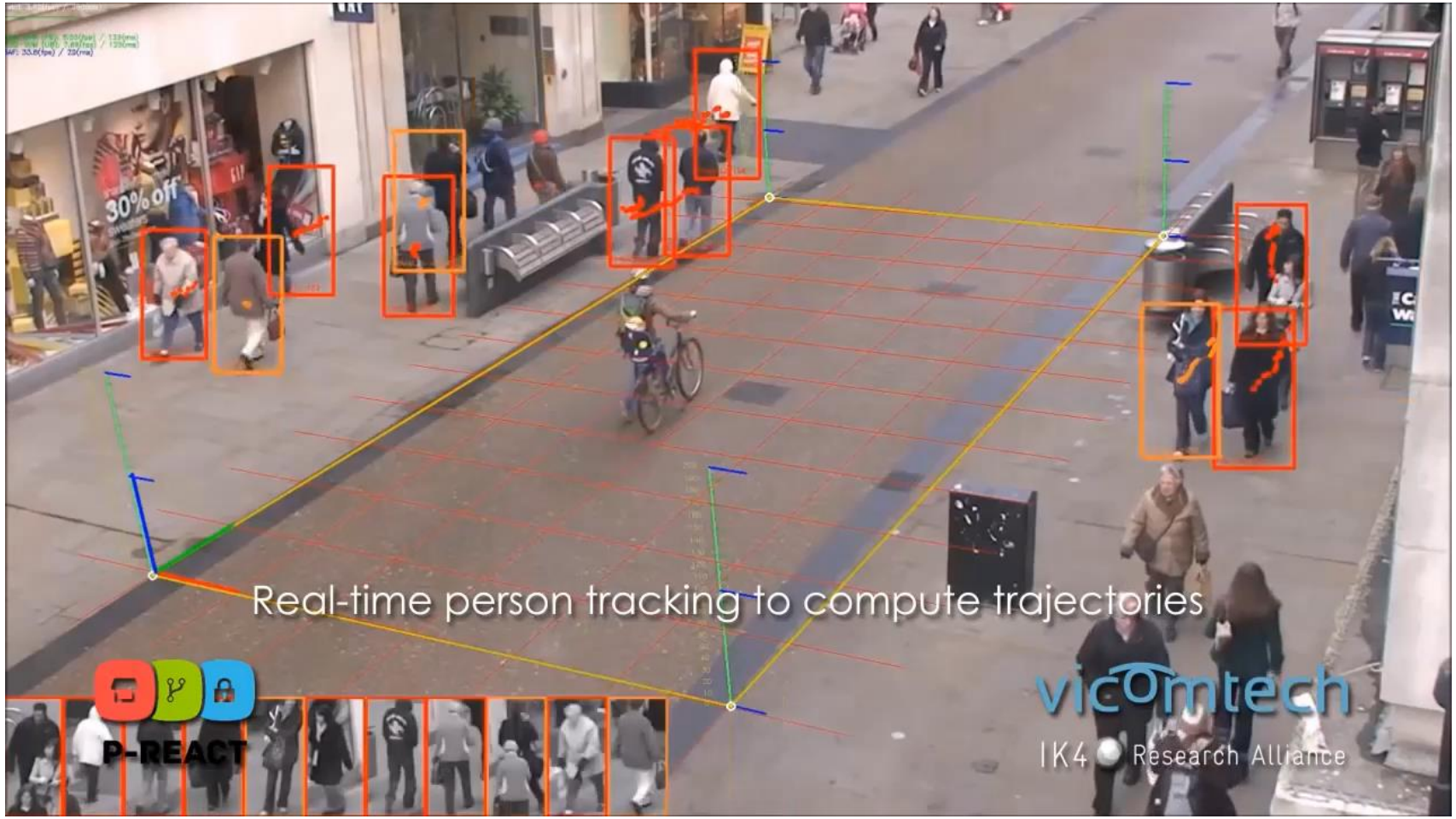
People Detection & Tracking





Videosurvelance & Security



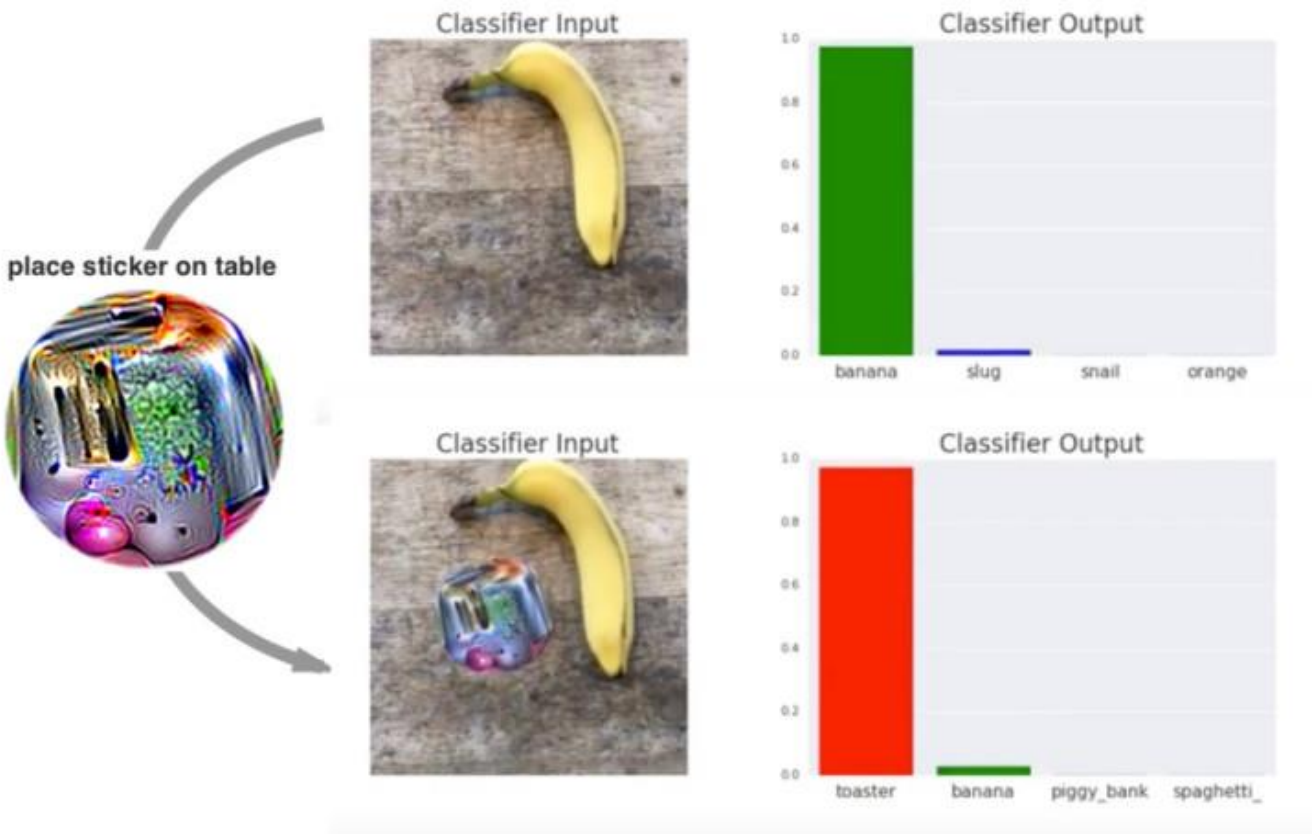


Riconoscimento semantico a livello di singolo pixel

Opps mi sono sbagliato ...

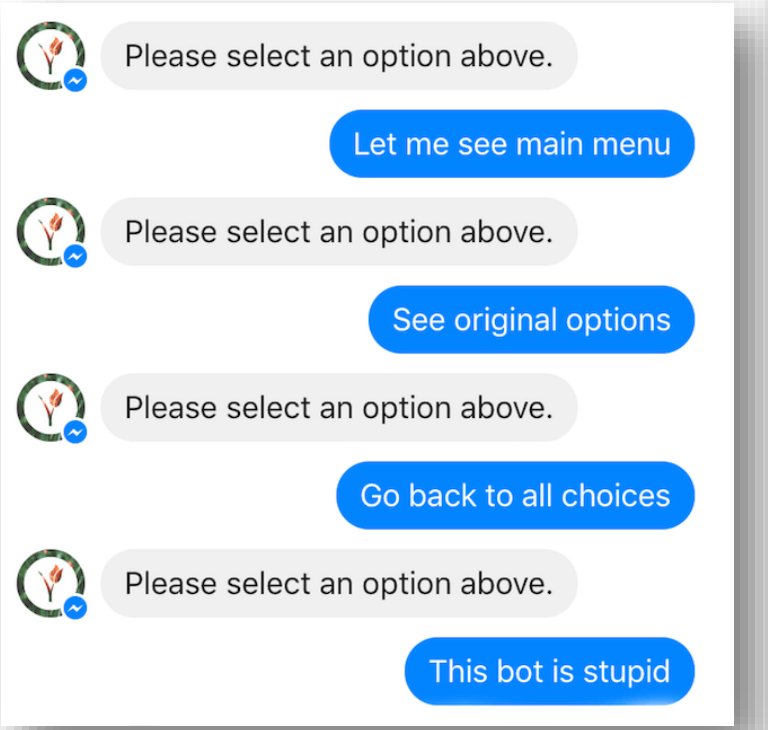
Bernard Parker, left, was erroneously rated high risk; Dylan Fugett was erroneously rated low. (Josh Ritchie for ProPublica)

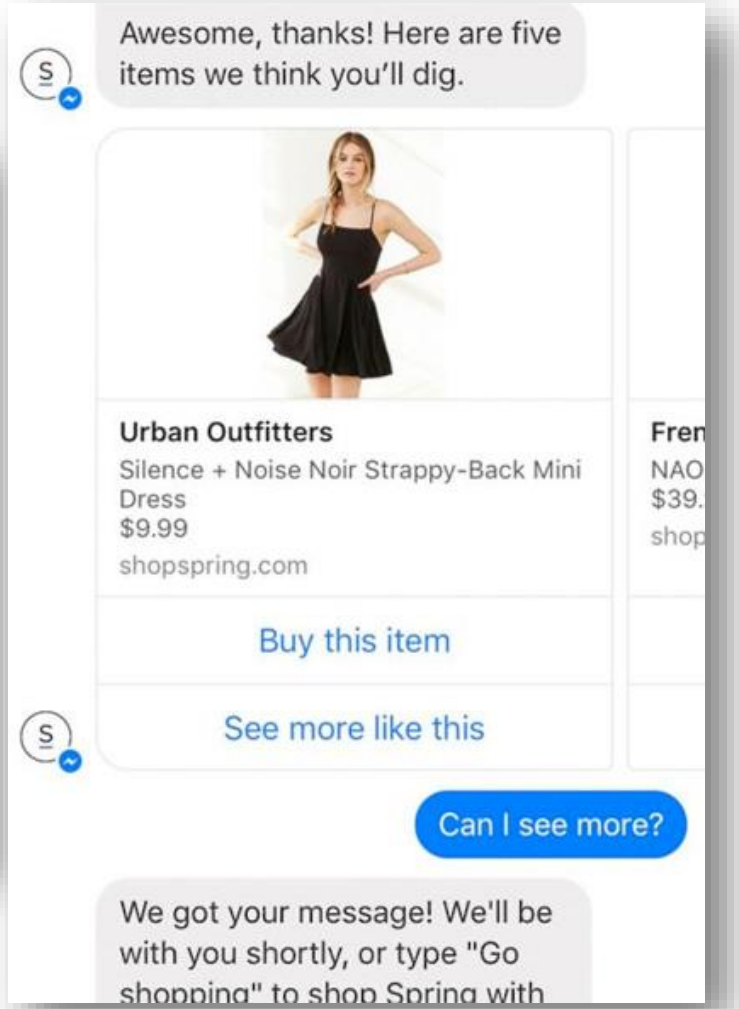
Opps mi sono sbagliato ...

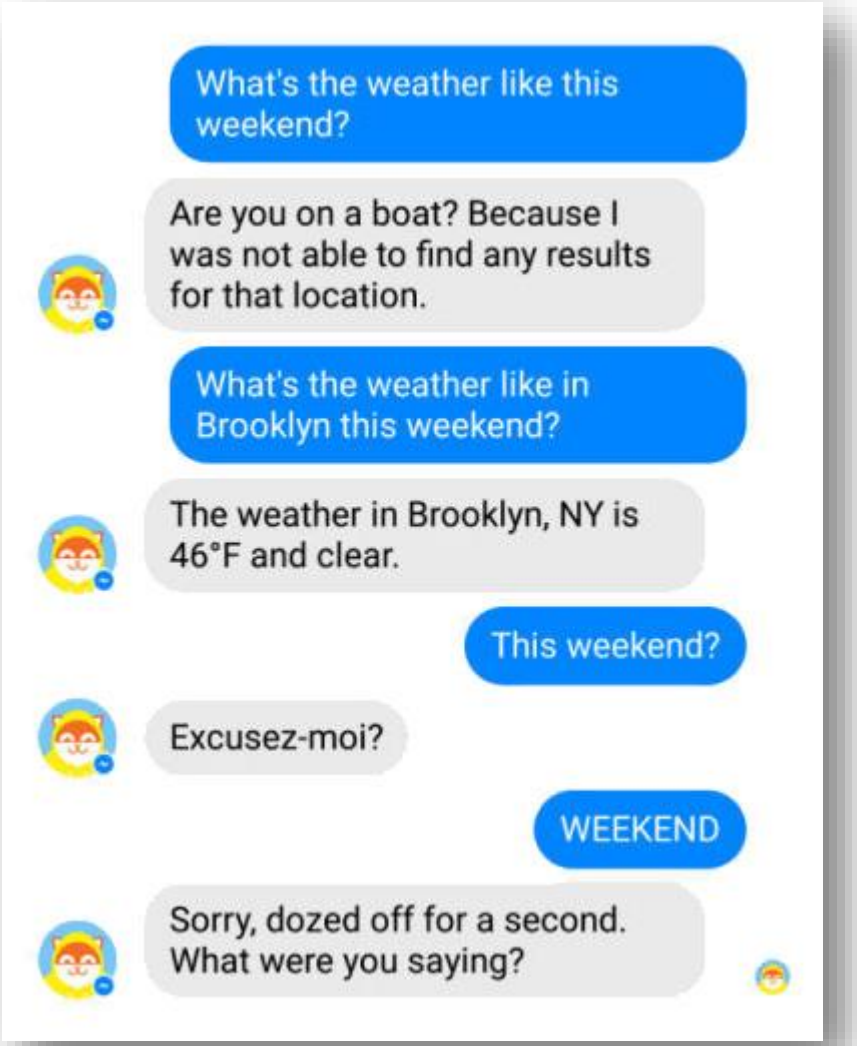


45 Mph 45 Mph Stop

Opps mi sono sbagliato ...



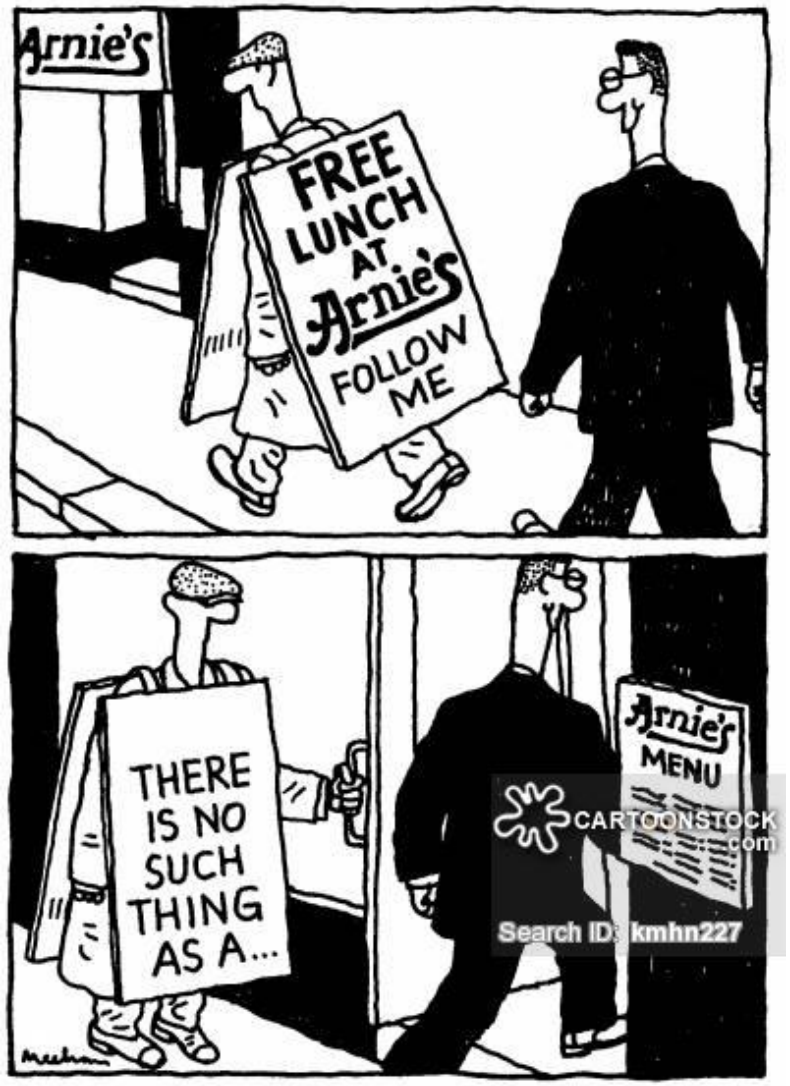




«There's no Free Lunch»

Impressionanti successi e clamorose disfatte a parte, dall'intelligenza artificiale possiamo attenderci:

- Che saranno necessari molti dati
- Che sara' difficile incorporare conoscenze a priori
- Che richidera' un diverso processo di sviluppo (i dati definiranno le specifiche dell'applicazione)
- Che saranno necessari molti piu' dati!



POLITECNICO
MILANO 1863

AIRLAB
ARTIFICIAL INTELLIGENCE AND ROBOTICS LAB

Cosa intendiamo per Intelligenza Artificiale?

… tutto ciò che avreste voluto sapere e non avete mai osato chiedere!

Matteo Matteucci
matteo.matteucci@polimi.it

Artificial Intelligence and Robotics Lab - Politecnico di Milano